

**INPUT DEVICE, ELECTRO-OPTICAL DEVICE,  
ELECTRONIC APPARATUS, METHOD OF  
MANUFACTURING INPUT DEVICE, AND  
METHOD OF MANUFACTURING  
ELECTRO-OPTICAL DEVICE**

**BACKGROUND OF THE INVENTION**

**[0001]** 1. Technical Field

**[0002]** The present invention relates to an input device such as a touch panel or the like, an electro-optical device having the input device, an electronic apparatus, a method of manufacturing the input device, and a method of manufacturing the electro-optical device.

**[0003]** 2. Related Art

**[0004]** In recent years, with the spread of small information electronic apparatuses such as personal digital assistant (PDAs), palmtop computers or the like, a liquid crystal display device in which a touch panel is mounted on a liquid crystal panel as an input device has been widely used. As a touch panel, a resistive film type in which two substrates, each having a resistive film such as ITO or the like, are bonded with a spacer interposed therebetween is known. The resistive film-type touch panel has a structure in which two substrates, each having a planar electrode made of ITO or the like, are arranged to face each other at a predetermined gap and a wiring section for deriving signals is formed at an edge of the planar electrode of one of the substrates. In such a liquid crystal display device, a screen of the liquid crystal panel can be viewed through the transparent touch panel and the touch panel is touched by a finger or a pen according to an instruction on the screen to be viewed, such that positional information of the touched portion can be input (see Japanese Unexamined Patent Application Publication No. 2003-43450).

**[0005]** In the related art, in order to provide a touch panel which is thin and light in weight, one or both of the opposite substrates are made of a plastic film substrate. However, since the plastic film substrate generates large deflection due to an input load, when an input is performed, a crack is generated in a resistive film and thus input characteristics deteriorate. Further, since the plastic film substrate has a low heat-resistant temperature, a high-temperature heat treatment cannot be performed at the time of the film formation. Accordingly, only a film having low transmittance is obtained. Further, since the plastic film substrate corrodes by an etchant, in the touch panel of the related art, a conductive material, such as silver paste or the like, which can be formed by means of printing methods is used for a wiring portion. Such a conductive material has a large resistance (for example, a specific resistance of silver paste is about  $3 \times 10^{-4}$ ) as compared to a metal film which is formed by means of sputtering methods. Thus, in order to ensure sufficient conductance, a line width needs to be widened and a large substrate region for the wiring portion is required. Further, since silver paste has a large interfacial resistance with respect to the planar electrode made of ITO or the like, an equi-potential line may be partially distorted and sufficient detection precision may not be obtained. In addition, the plastic film substrate has optical anisotropy. Accordingly, in an inner-type liquid crystal display device in which a liquid crystal panel and a touch panel are integrated with two optical films (polarizing plate and the like) interposed there-

between, sufficient display characteristics cannot be obtained. A plastic film substrate which does not have optical anisotropy is expensive, thus the manufacturing cost of a device is increased.

**[0006]** As a countermeasure against the above-described problems, a configuration in which both substrates of the touch panel are made of hard glass substrates has been considered. In such a touch panel, since the hardness of the substrate is high, the substrate is not deformed by so much when the input is performed. Further, since the glass substrate has high heat-resistance, the quality of the resistive film itself can be improved by the high-temperature heat treatment. For this reason, the resistive film hardly deteriorates though used for a long time, such that an input device having high durability is obtained. Further, with the improvement of the quality of the resistive film, transmittance is increased, such that a bright display device can also be constructed. However, in the case in which the glass substrate having high hardness is adopted, the input load is increased or the substrate is not deflected so easy when an input is performed, such that the detection precision of an input position is degraded. In this case, when the substrate is reduced in thickness to 0.1 mm, the above-described problems do not occur. However, if the substrate is reduced in thickness, it is hard to handle the substrate or the substrate may be cracked during the manufacturing process. Further, since the substrate is vulnerable to a mechanical impact, when the touch panel is used for portable devices, it is likely to be damaged by an impact such as being dropped.

**[0007]** Here, a case in which the resistive film-type touch panel is used as the input device is described. In addition to the resistive film-type touch panel, as a touch panel, a capacitive touch panel or an ultrasonic touch panel is known. The above-described problems are common to the other types of touch panels. Further, even when the liquid crystal panel is substituted with other display panels such as organic electroluminescent (EL) panels or the like, the same problems occur.

**SUMMARY**

**[0008]** An advantage of the invention is that it provides an input device, such as a touch panel which uses a glass substrate, which can reduce an input load at the time of an input operation, enhance detection precision, and easily handle a substrate during a manufacturing process, an electro-optical device, an electronic apparatus, a method of manufacturing the input device, and a method of manufacturing the electro-optical device.

**[0009]** According to a first aspect of the invention, an input device includes a first substrate that has a coordinate input surface, and a second substrate that faces the first substrate. A position on the coordinate input surface of the first substrate is directly indicated, such that coordinate information at the indicated position is input. The first substrate and the second substrate are made of glass substrates. Further, according to the coordinate input surface of the first substrate, a thin-plate region having a reduced thickness than the periphery of the coordinate input surface is formed. In this case, the thin-plate region may be deflectably reduced in thickness.

**[0010]** As described above, in the input device which uses the glass substrate, in view of ease of handling the substrate